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August 4, 2005

Via E-mail
wtc@nist.gov

S. Shyam Sunder, Ph.D.
NIST
WTC Technical Information Repository
Gaithersburg, MD 20899-8610

Re: Review Comments to NIST NCSTAR 1 (Draft)

Dear Dr. Sunder:

Enclosed are review comments related to the referenced draft report. The comments focus on NIST's 30 recommendations, since these encompass the thoughts and findings presented throughout the report. Since there wasn't time for a company peer review, please consider this response submission as that from an individual in the field of fire protection engineering rather than those of Schirmer Engineering.

Recommendation 4 – Replace the word "construction" with "building" with reference to determination of an appropriate classification. The codes already have established construction type classifications based on a much different set of criteria. The criteria that are being proposed go much beyond just construction considerations by also including building systems.

Recommendation 5 – I agree in principle with the recommendation, however, this is a lofty goal requiring extensive research for years to come. There is also the politics of the standardization process that will have to be overcome for implementation.

Footnote 25 references text recommending that construction classifications and fire rating requirements need examination. The footnote seems to favor increasing structural fire resistance in high-rise buildings, but then talks about buildings 420 feet and higher having a 4-hour requirement. The question is, how much higher could fire resistance ratings expect to go?

Recommendation 11 – It is first necessary to study and establish the behavior of the referenced high-performance materials under standard fire conditions before they can be evaluated under conditions expected in building fires. Part of the process may include establishing a correlation between standard fire test conditions and those of actual building fires.

Recommendation 12 – The enhancement of the performance and redundancy of active fire protection systems could be equated to better design layout. This could include, for example, double feed sprinkler systems with remoteness of supply risers.

Recommendation 13 – Suggest exploring the possibility of wireless technologies for some communication devices to eliminate the damage potential of hard-wired systems.

Recommendation 14 – The general concept is desirable, but information returned to the Command Panel on water flow rates and pressures would not seem to be very useful in a fire situation. Room temperatures at various floor locations would appear to be more useful.

Recommendation 15 – Off-site collection and storage of data is more suited for after-the-event usage. Relying on signals from an off-site location during the event adds one more degree of failure into the equation. If the on-site equipment cannot adequately perform during the fire or disaster event due to damaged systems, then off-site data collection and transmission will also be ineffective.

Recommendation 16 – None of the referenced activities will overcome the physical challenges of a person being able to descend numerous stories through a stairway during an evacuation process of these ultra-high-rise buildings. It was mentioned the NYC doesn't permit full building evacuation training during drills. The rigors of navigating down numerous flights of stairs is a problem that must be addressed.

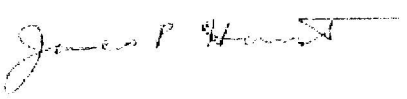
Recommendation 17 – Additional exit capacity for emergency responders is a good idea. Hardened side-by-side stairs with rated sight glass could be used in the separation wall to permit occupants and firefighters get first-hand knowledge of conditions in each of the stairs. Also, subsection b addresses mobility-challenged occupants. Whatever techniques are available that will increase the effectiveness of the evacuation process should be extended to all occupants, not just those who are physically challenged. The use of elevators should be increased during the disaster event through a more robust design of elevators and their shafts. (I see that Recommendation 21 addresses this consideration).

Recommendation 18 – Item c – If the construction of the scissor stairs is sufficiently robust and penetrations are adequately firestopped, then the stairs should get counted as two stairs.

Recommendation 26 – This recommendation involves increasing egress and sprinkler requirements for existing buildings and seems to suggest that these measures be taken irregardless of significant renovation work being done. If this is the case, the implementation is likely to be cost prohibitive. Existing high-rise buildings should be considered for upgrading of life-safety features on a case-by-case basis such as iconic buildings, for example. This shouldn't be expected to be done over a broad scale.

All in all, I thought the report was a very impressive body of work.

Very truly yours,



James P. Hurst, P.E.

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August 2, 2005

VIA FAX
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WTC Technical Information Repository
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Re: NIST NCSTAR 1 (Draft)
Public comments

Gentlemen:

Schirmer Engineering Corporation is recognized as the nation's first private fire protection engineering consulting firm, founded in 1939, and today consists of more than 220 professionals working to make the built environment safe from fire. We are pleased to have this opportunity to provide comments on the NIST NCSTAR Draft report on the collapses of the World Trade Center Towers. NIST is to be commended on the comprehensive nature of the investigation and the analytical tools developed in response to the assignment.

A thorough review of the report was not possible during the limited time frame for public comments; an additional comment period would be appreciated. Nevertheless, we are providing comments for consideration in a number of subject areas, as follows.

Recommendation 4. **NIST recommends evaluating, and where needing improving, the technical basis for determining appropriate construction classification and fire rating requirements (especially for tall buildings greater than 20 stories in height) – and making related code changes now as much as possible – by explicitly considering factors including:**

- **timely access by emergency responders and full evacuation of occupants, or the time required for burnout without local collapse;**
- **the extent to which redundancy in active fire protection (sprinkler and standpipe, fire alarm, and smoke management) systems should be credited for occupant life safety;**
- **the need for redundancy in fire protection systems that are critical to structural integrity;**

- **the ability of the structure and local floor systems to withstand a maximum credible fire scenario without collapse, recognizing that sprinklers could be compromised, not operational, or non-existent;**

- **compartmentation requirements (e.g., 12,000 ft^2) to protect the structure, including fire rated doors and automatic enclosures, and limiting air supply (e.g., thermally resistant window assemblies) to retard fire spread in buildings with large, open floor plans;**

- **the impact of spaces containing unusually large fuel concentrations for the expected occupancy of the building; and**

- **the extent to which fire control systems, including suppression by automatic or manual means, should be credited as part of the prevention of fire spread.**

This recommendation includes many issues which warrant commentary. However, due to the limited comment period, we wish to focus on one important portion of this recommendation, compartmentation. Many buildings – both high-rise and low-rise – employ large, open areas in order to fulfill the desired function of the space and/or to fulfill that function in an economical manner. For years, these large building areas were recognized as being able to fulfill the functional and economic goals by limiting potential fire spread by means of active suppression systems. Indeed, as the fire protection community realized after initially allowing a compartmentation "option" for high-rise buildings in the 1970s and 1980s, automatic sprinkler protection was considered more effective and reliable when compared to the compartmentation option which has since been eliminated.

Building owners and operators must be given an option to conduct operations in a safe, cost-effective manner as has been demonstrated to occur in properly designed and operated buildings employing other fire protection strategies such as automatic sprinkler protection. We agree, however, that as building height increases such that building evacuation becomes more difficult or even impossible, the reliability of the active fire suppression systems becomes more important and should be improved by methods such as redundant water supplies, redundant risers, redundant fire pumps and associated power supplies, electrical supervision of the system and off-site monitoring. Such reviews are considered part of the design process employed by professional fire protection engineers who may be engaged on such projects and are subject to a number of project-specific variables.

The recommendation to limit compartment sizes in tall buildings is not supported by technical information or historical data, other than the extreme events of 9/11 and, therefore, should be removed from the report.

Recommendation 12. **NIST recommends that the performance and redundancy of active fire protection systems (sprinklers, standpipes/hoses, fire alarms, and smoke management systems) in buildings should be enhanced to accommodate the greater risks associated with increasing building height and population, increased use of open spaces, available compartmentation, high-risk building activities, fire department response limits, transient fuel loads, and higher threat profile.** The performance attributes should deal realistically with the system design basis, reliability of automatic/manual operations, redundancy, and reduction of vulnerabilities due to single point failures. *Affected National Standards:* NFPA 1, NFPA 13, NFPA 72, NFPA 90A, and NFPA 101. *National Model Building Codes:* The performance standards should be adopted in national model building codes by mandatory reference to, or incorporation of, the latest edition of the standard.

Schirmer Engineering Corporation recommends that the wording, "be enhanced to accommodate the greater risks," be changed to "evaluated and possibly enhanced to accommodate the potentially increased risks." The current NIST recommendation appears to be vague and without technical substantiation.

With respect to the sprinkler systems, the report indicates that the systems were designed to produce densities significantly greater than NFPA 13. It also concludes that the system could not be expected to provide protection to the extreme conditions that occurred on September 11, 2001. The water supply also had several secondary and back-up conditions. As the report indicates that the sprinkler systems could not be expected to protect against the extreme conditions and that the New York City Fire Department (FDNY) decided against fighting the fire, the water supply would appear "adequate." In actuality, the building's water supply had several redundant features that exceeded codes. Although manual operation of some secondary pumps was noted in the report, we agree that automatic operation is preferred. For this item, it is suggested that automatic operation would be designed in the 2000s, where manual was acceptable in the 1960s and 1970s. For water supply, we therefore do not see any significant code changes.

The report indicates that the fire alarm system included manual operation of the occupant notification system. Apparently, occupancy notification alarms occurred 12 minutes after impact. The current code, NPFA 72 suggests shorter periods with specific limitations for reliability. In essence, the current code does address this condition.

The report also suggests that the use of the smoke control system would not have provided added protection to change the outcome. It also indicated that the system was manual and that smoke dampers were not provided at duct openings to shafts. Currently, the International Building Code (IBC) requires smoke dampers at shafts. The technical committee of NFPA 90A recently approved a code change to include smoke dampers at shafts. The IBC indicates that operation of smoke control is to be automatic. We therefore do not see any significant code changes.

The term "risk" should be carefully used. Currently, there is a perceived higher risk level by the general public with respect to high-rise buildings. Although protection should be consistent with the risk level, higher protection levels based on a perceived risk should be avoided. It is also recognized that under some conditions, any level of risk is unacceptable.

In lieu of a broad, code-mandated increase in system performance and redundancy, we suggest that a performance-based analysis be required for unique or iconic structures consistent with the "greater risks" noted in the NIST recommendations.

Recommendation 13. **NIST recommends that fire alarm and communications systems in buildings should be developed to provide continuous, reliable, and accurate information on the status of life safety conditions at a level of detail sufficient to manage the evacuation process in building fire emergencies, and that standards for their performance be developed.** This should include means to maintain communications with evacuating occupants that can both reassure them and redirect them if conditions change. While pre-installed fire warden telephone system in buildings can serve a useful purpose and may be installed in buildings, they should be made available for use by emergency responders. Pre-installed dedicated firefighter telephone systems in buildings are of limited use and effectiveness, and their installation is not encouraged. *Affected National Standards:* NFPA 1, NFPA 72, and NFPA 101. *National Model Building and Fire Codes:* The performance standards should be adopted in national model building and fire codes by mandatory reference to, or incorporation of, the latest edition of the standard.

It is agreed that fire alarm and communication systems should provide continuous, reliable, and accurate information on the status of life safety conditions at a level of detail sufficient to manage the evacuation process.

Improved communications with existing technology can be as simple as proper zoning of communication system. NFPA 72 does not include zoning requirements. In general this has been a design issue related to the building specifics and fire department requirements. Standards would assist to unify zoning requirements. It is recommended that such requirements be performance based.

Two-way communication systems should be further evaluated on an overall basis by all stakeholders. Although firefighters in one of the Towers were given headsets, the report indicates that the firefighter's two-way system was not used. Handheld walkie-talkies were used by firefighters with mixed results even though a repeater had been installed after the 1993 incident. The fire warden telephone system was apparently not used. Based on the above information, it is not clear why Recommendation 13 includes information that fire warden telephone systems in buildings can serve as a useful purpose and that firefighter telephone systems are not encouraged. Technologies, including the allocation of appropriate radio frequencies, should be explored that allow better communications in steel and concrete tall buildings

Recommendation 14. **NIST recommends that control panels at fire/emergency command stations in buildings should be adapted to accept and interpret a larger quantity of more reliable information from the active fire protection systems that provide tactical decision aides to fireground commanders, including water flow rates from pressure and flow measurement devices, and that standards for their performance be developed.** *Affected National Standards:* NFPA 1, NFPA 72, and NFPA 101. *National Model Building and Fire Codes:* The performance standards should be adopted in national model building and fire codes by mandatory reference to, or incorporation of, the latest edition of the standard.

It is agreed that some additional information from active fire protection systems may be helpful. However, it is suggested that "waterflow rates from pressure and flow measurement devices" may not be helpful and that this level of detailed information could be more negative than positive. Information at this level would require a detailed knowledge of the building and its systems for it to be useful. Although the "waterflow" rate could suggest a hose is being operated from standpipe, this information can be obtained from the firefighting unit. In large complicated buildings, sometimes making it simple is best of all.

Recommendation 15. **NIST recommends that systems should be developed and implemented for: (1) real-time off-site secure transmission of valuable information from fire alarm and other monitored building systems for use by emergency responders, at any location, to enhance situational awareness and response decisions and maintain safe and efficient operations; and (2) preservation of that information either off-site or in a black box that will survive a fire or other building failure for purposes of subsequent investigations and analysis. Standards for the performance of such systems should be developed, and their use should be required.** *Affected National Standards:* NFPA 1, NFPA 72, and NFPA 101. *National Model Building and Fire Code:* The performance standards should be adopted in national model building and fire codes by mandatory reference to, or incorporation of, the latest edition of the standard.

Schirmer Engineering Corporation believes that additional information should be provided to emergency responses during their responses, if possible. This would require additional equipment from other building owners, emergency dispatch, and emergency responders.

Preservation of information via black box or off-site is not considered necessary at this time. Although this information is helpful in an investigation, resources should be spent in areas where preservation of life and property is more direct.

General Comment on Improved Active Fire Protection

For the most part, active fire protection systems were adequate and were not a major part in the outcome of September 11, 2001. The NIST recommendations are very generic.

The major single theme is for improved communications. This would include improved reliability of communication system along with the systems providing other information. As technology improves, it is hopeful that better information can be provided in a cost-effective manner. The benefits of additional hardware must be tangible, measurable, or else the requirements will simply add a cost burden to construction. Caution must be also be exercised to assure that information communicated to building occupants is meaningful and useful towards evacuation of occupants, conservation of property, and safety of emergency responders. The building included a two-way communication system for firefighters and, apparently, this system was not used. NIST concludes that the installation of these systems "is not encouraged." Providing additional information or equipment, which is not used, is of no value.

Recommendation 16. **NIST recommends that public agencies, non-profit organizations concerned with building and fire safety, and building owners and managers should develop and carry out public education campaigns, jointly and on a nationwide scale, to improve building occupants' preparedness for evacuation in case of building emergencies. This effort should include better training and self-preparation of occupants, an effectively implemented system of floor wardens and building safety personnel, and needed improvements to standards.**

We support this recommendation for training and occupant preparedness, since training and drills that provide proper instruction on the evacuation options will help occupants make correct evacuation decisions (e.g., use stairs or use elevators, etc.).

Recommendation 17. NIST recommends that tall buildings should be designed to accommodate timely full building evacuation of occupants due to building-specific or large-scale emergencies such as widespread power outages, major earthquakes, tornadoes, hurricanes without sufficient advanced warning, fires, accidental explosions, and terrorist attack. Building size, population, function, and iconic status should be taken into account in designing the egress system. Stairwell and exit capacity should be adequate to accommodate counterflow due to emergency access by responders.

Recommendation 17 is noted per Table 9-1 to be both related and unrelated to 9/11 outcome and applicable to all tall buildings and other structures. We find this recommendation to be overreaching and inconsistent with philosophy taken on structural recommendations. First, it is clear that the structural recommendations for the design of buildings do not require that tall buildings be designed to resist or accommodate the direct hit of a jet airliner by terrorists, yet Recommendation 17 requires that a terrorist attack, which could be any one of a number of possible scenarios for any given building, be the basis upon which to design the egress system. Designing, or attempting to design, an egress system for a given scenario can provide owners and occupants a false sense of security because of the myriad number of types and scenarios of extreme events, i.e., a design for "Event A" may not be adequate for an "Event B" that was not contemplated. Clearly, the design of a building's egress system for all possible events is not possible.

Also, for other large-scale emergencies such as hurricane, tornado, earthquake, it is not clear in the report how full-scale evacuation is necessary or the rationally appropriate action to be taken and, in fact, may be inappropriate for many types of occupancies (e.g., hospitals and senior residential living). For many buildings, the evacuation strategy and building design features need to consider the needs of the occupants without utilizing full building evacuation.

The last sentence of Recommendation 17 states, "Stairwell and exit capacity should be adequate to accommodate counterflow due to emergency access by responders." The data and details of the NIST NCSTAR documents do not support this as a final recommendation. While counterflow was noted between responders on the occupants in the stairwells, the data and analysis in no way supports or provides a basis for the definitive and broad recommendation as cited in Recommendation 17 for counterflow.

In NIST NCSTAR 1-7, the document states that few building occupants felt that counterflow on the stairways had much effect on their evacuation. Also, on page 8 of NIST NCSTAR 1-8, "In contrast, many emergency responders suggested that counterflow on the stairways in WTC 1

generally had a negative impact on the emergency responder operations." Further, analysis is needed to validate if the perceptions of the emergency responders was in fact evidence of a problem and whether or the 9/11 events equates to a problem for credible, non-terroristic emergency events.

From the standpoint of occupant egress, the recommendation is not supported. From the perspective of emergency responders, the negative conditions reported by emergency responders were a direct function of the magnitude of the terrorist attack which eliminated elevator usage, compromised stairways and forced a large-scale evacuation as opposed to a partial or phased evacuation. The events of 9/11 did not represent credible egress expectations for credible fires, but rather an extreme terrorist event in tall buildings. As the recommendation to accommodate counterflow is related to the 9/11 outcome, it is too broad to be considered applicable to other buildings (as noted per Table 9-1) without consideration for the nature of the occupancy, nature of building height, area fire separations, architectural arrangement, evacuation procedures, elevator service arrangement, and the credible fire scenarios for any given building.

We recommend that this recommendation be eliminated or modified to read that the potential for full building evacuation should simply be considered and take into account factors such as a building's iconic status, its geo-political environment, its susceptibility to earthquakes, hurricanes and other natural hazards, etc.

Again, thank you for this opportunity. We look forward to reviewing the final report.

Very truly yours,

SCHIRMER ENGINEERING CORPORATION

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